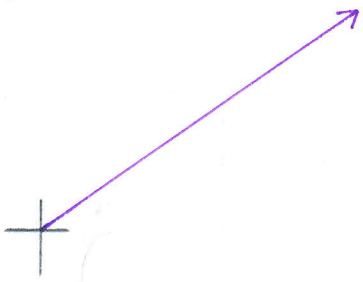
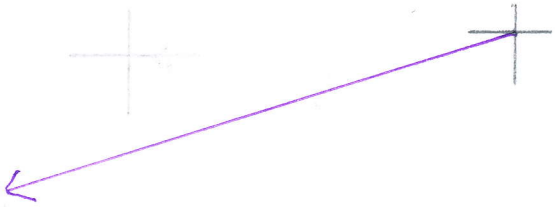
Vectors

I.

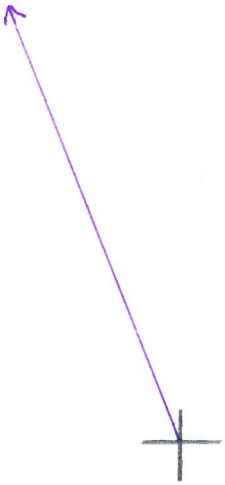
1) 1cm = 50m



3) 1cm = 14Km

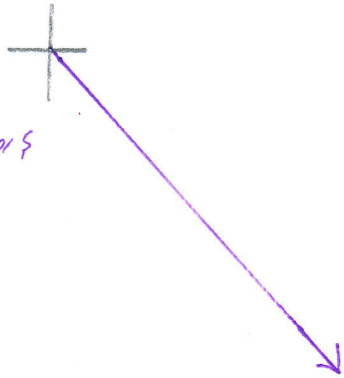


5) 1cm = 6 Km/h



7)

1cm = 5m/s

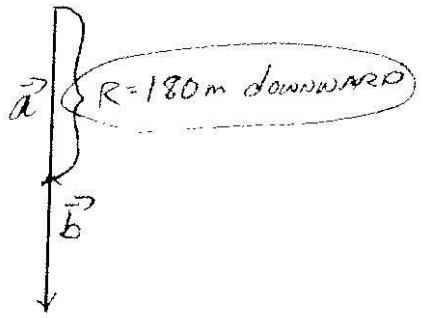


Physics 30 Vector Assign.

Addition of Vectors (Graphical)

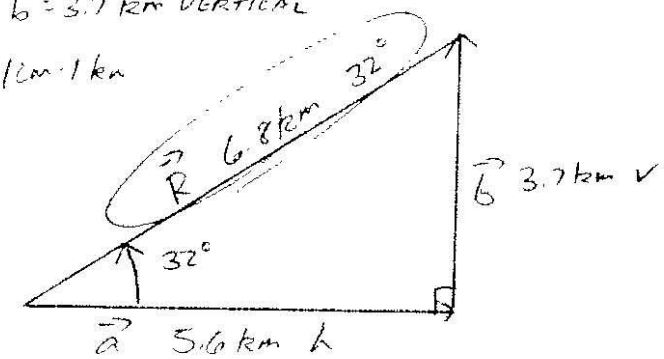
II 1) $\vec{a}$ = 320 m downward
$\vec{b}$ = 140 m upward

1 cm : 80 m



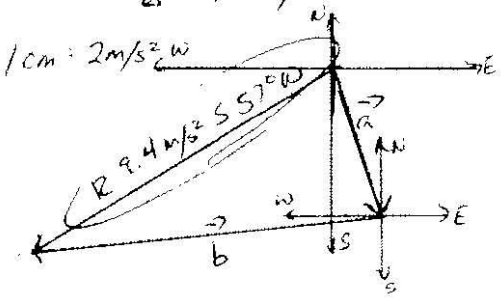
2) $\vec{a}$ = 5.6 km horizontal
$\vec{b}$ = 3.7 km vertical

1 cm : 1 km



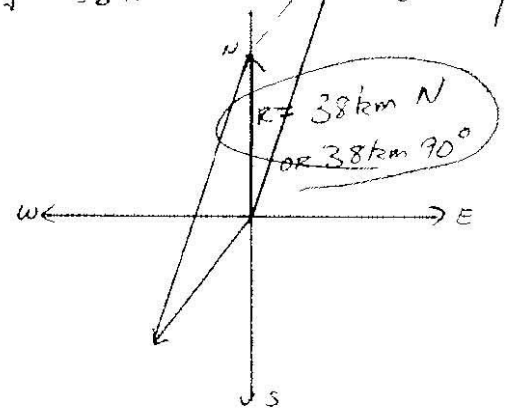
3) $\vec{a}$ = 3.97 m/s² at S 57° E
$\vec{b}$ = 9.2 m/s² at S 84° W

1 cm : 2 m/s² W



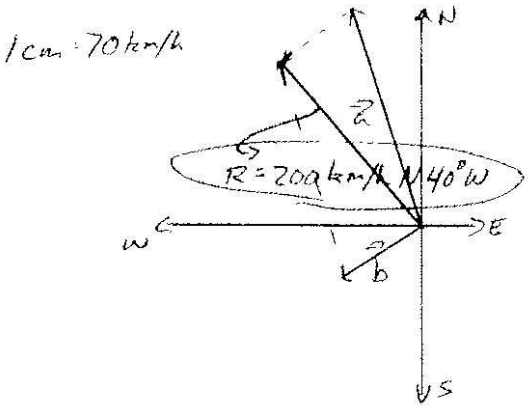
4) $\vec{c}$ = 72 km at a course of 72°
$\vec{d}$ = 38 km at a course of 232°

1 cm : 18 km



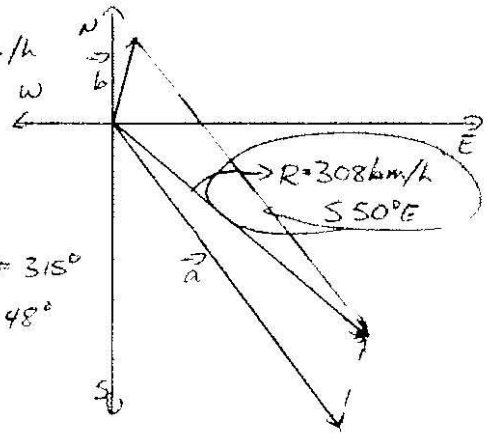
5) $\vec{a}$ = 210 km/h N 18° W
$\vec{b}$ = 85 km/h S 57° W

1 cm : 70 km/h



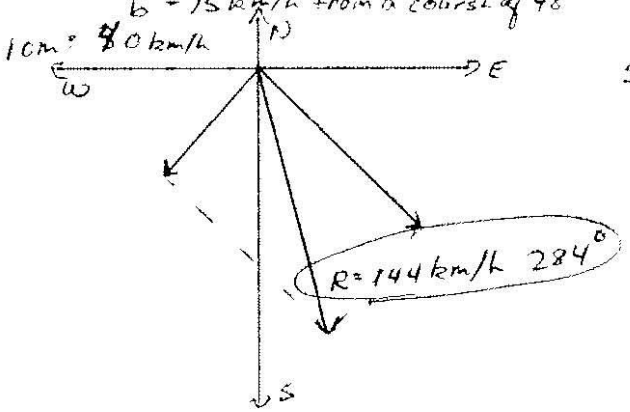
6) $\vec{a}$ = 350 km/h S 37° E
$\vec{b}$ = 80 km/h N 14° E

1 cm : 70 km/h



7) $\vec{a}$ = 120 km/h on a course of 315°
$\vec{b}$ = 75 km/h from a course of 48°

1 cm : 30 km/h



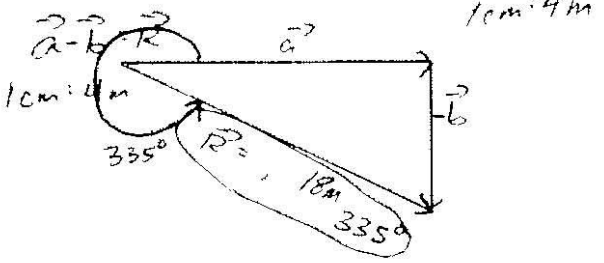
Subtraction of Vectors

III

1) a) $\vec{a}$ = 16.2 m horizontal

$\vec{b}$ = 7.8 m vertical

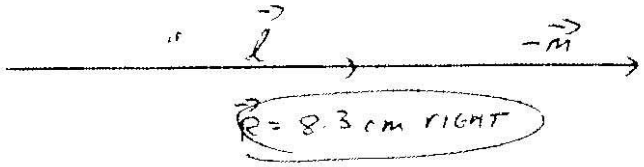
1 cm : 4 m



2) $\vec{l}$ = 4.6 cm RIGHT $\quad \vec{l}-\vec{m}=\vec{R}$

$\vec{m}$ = 3.7 cm LEFT

1 cm : 1 cm

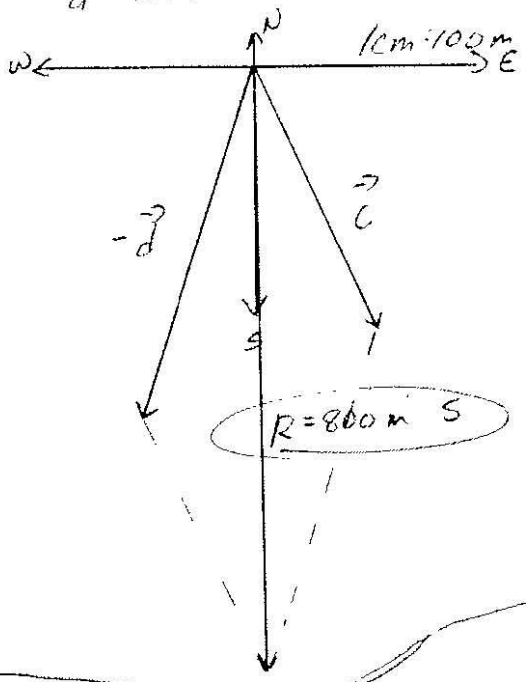


$\vec{R}$ = 8.3 cm RIGHT

3) $\vec{c}$ = 380 m S 24° E $\quad \vec{c}-\vec{d}=\vec{R}$

$\vec{d}$ = 475 m N 18° E

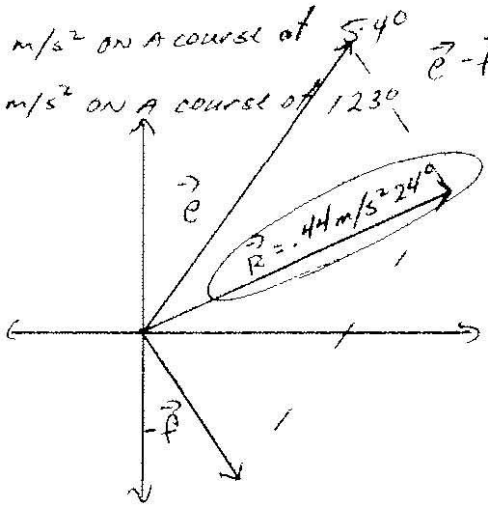
1 cm : 100 m



#4) $\vec{e}$ = 0.47 m/s² on A course of 54° $\quad \vec{e}-\vec{f}=\vec{R}$

$\vec{f}$ = 0.23 m/s² on A course of 123°

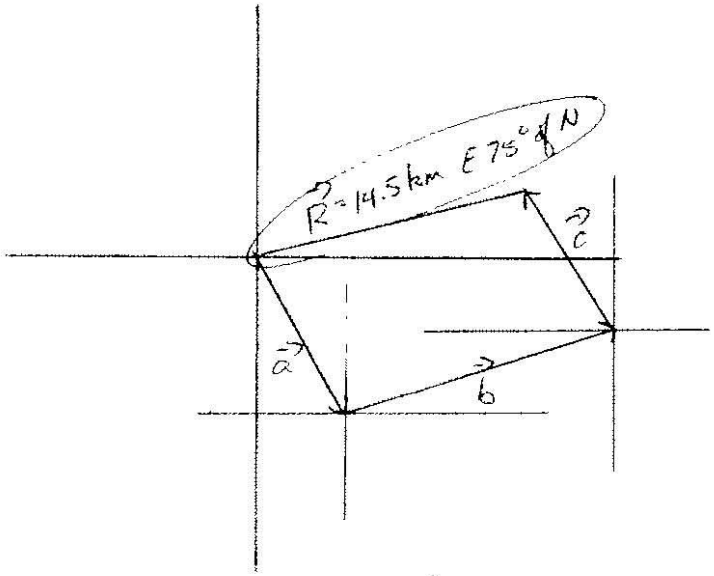
1 cm : 0.1 m/s²



2) $\vec{a}$ = 9.4 km at 29° E of S

$\vec{b}$ = 14.6 km at 72° E of N $\quad$ 1 cm : 4 km

$\vec{c}$ = 8.7 km at 31° W of N



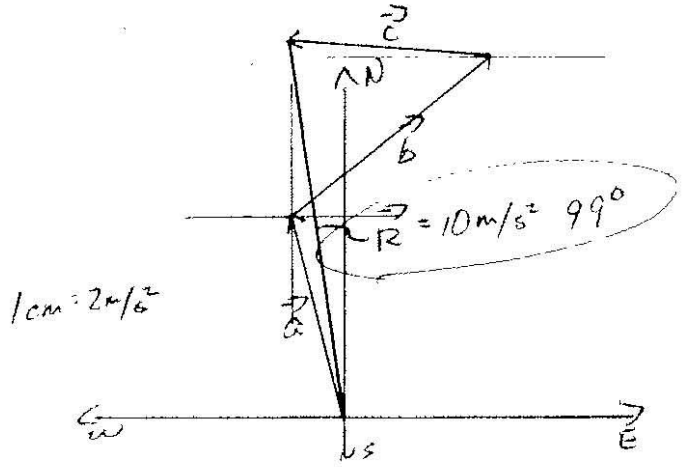
Addition of 3 or more Vectors

IV

1) $\vec{a}$ = 5.6 m/s² course of 115°

$\vec{b}$ = 6.7 m/s² course of 38°

$\vec{c}$ = 5.1 m/s² course of 176°



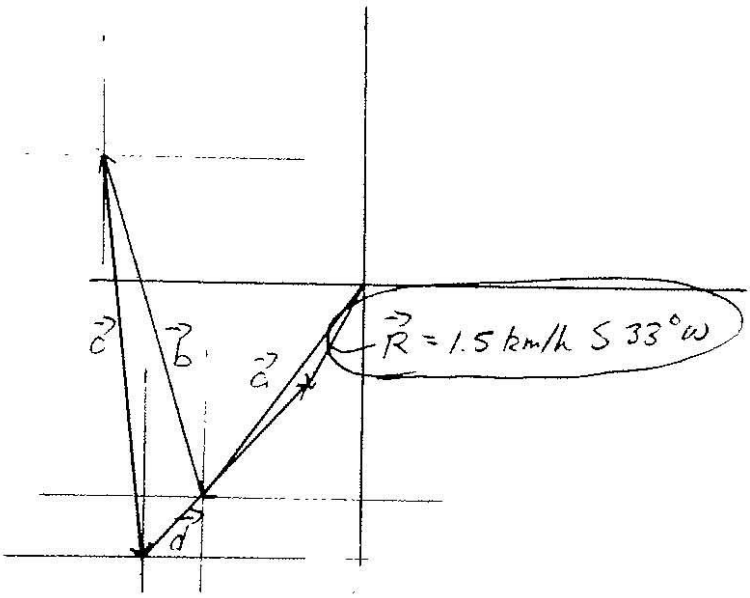
IV 3) $\vec{c}$ = 35 km/h at S 36° W

$\vec{b}$ = 47 km/h at N 17° W

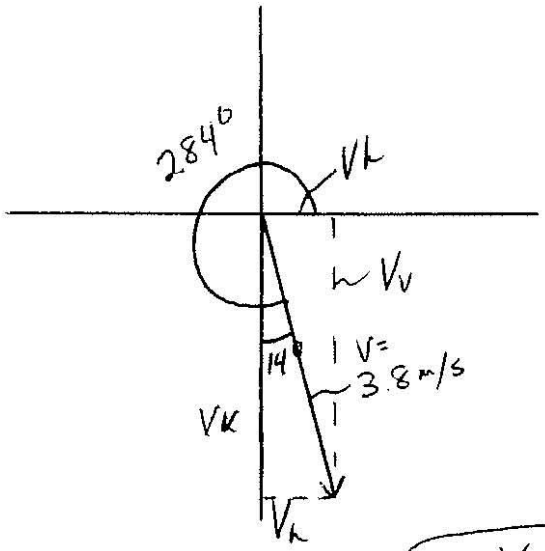
$\vec{a}$ = 53 km/h at 55° E

$\vec{d}$ = 31 km/h at N 42° E

1 cm : 1 km/h



V 1) 3.8 m/s on a course of 284°



$\sin\theta = \frac{opp}{hyp} \Rightarrow \sin 14° = \frac{V_h}{3.8\ m/s}$ 0°

$V_h = 3.8\ m/s (\sin 14°) = 0.92\ m/s$

$\cos\theta = \frac{adj}{hyp} \Rightarrow \cos 14° = \frac{-V_V}{3.8\ m/s}$

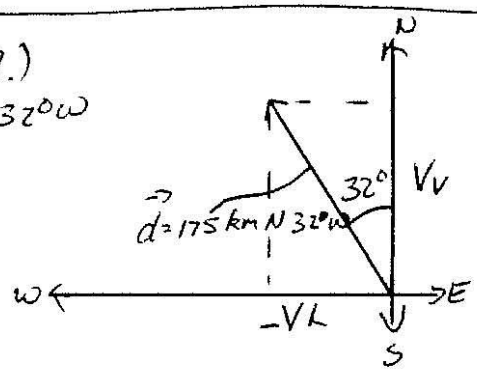
$-V_V = 3.8\ m/s \cos 14°$

$V_V = -3.7\ m/s$

$V_h = 0.92$ m/s 0° OR 3.7 m/s 270°

$V_V = -3.7$ m/s OR 3.7 m/s 270°

2.) 175 km N 32° W



$-\sin 32° = \frac{-V_h}{175\ km}$

$-V_h = 175\ km \sin 32 = +92.7\ km$

$V_h = -92.7\ km$

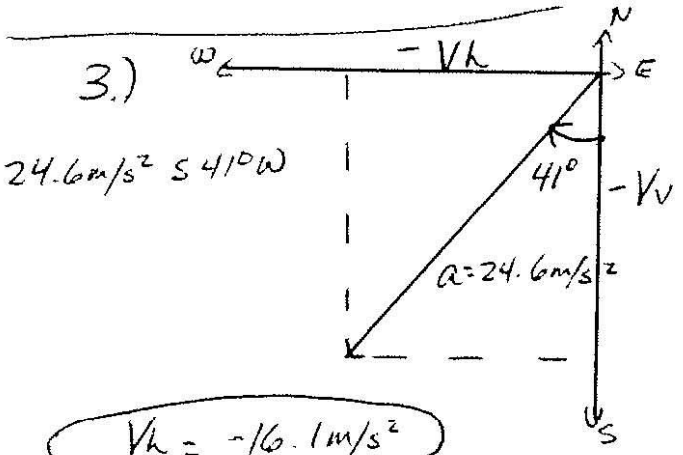
$\cos 32° = \frac{V_V}{175}$

$V_V = \cos 32° (175\ km) = 148.4\ km$

$V_h = -92.7$ km

$V_V = 148.4$ km

3.)



$24.6 m/s^2$ S 41° W

$\sin\alpha = \frac{OPP}{HYP}$

$\sin 41° = \frac{-V_h}{24.6}$

$-V_h = \sin 41° (24.6 m/s^2)$

$V_h = -16.1 m/s^2$

$\cos\alpha = \frac{ADJ}{HYP}$

$\cos 41° = \frac{-V_V}{24.6}$

$-V_V = \cos 41 (24.6 m/s^2)$

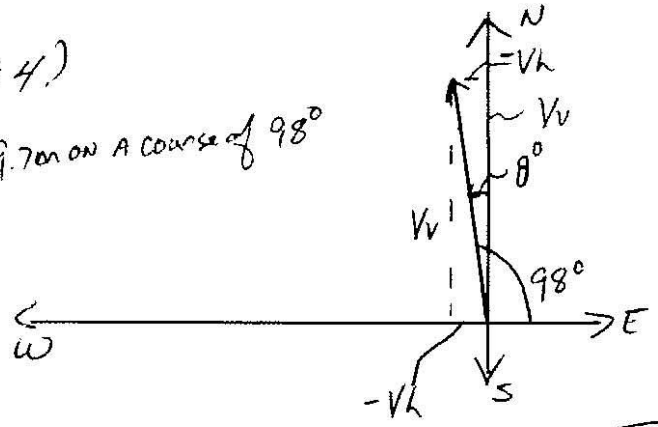
$V_V = -18.6 m/s^2$

$V_h = -16.1 m/s^2$

$V_V = -18.6 m/s^2$

#4.)

9.7m on A course of 98°



$\sin 8° = \frac{-V_h}{9.7m} \Rightarrow -V_h = \sin 8° (9.7m)$

$+ V_h = -1.35m$

$\cos 8° = \frac{+V_V}{9.7m} \Rightarrow V_V = \cos 8° (9.7m)$

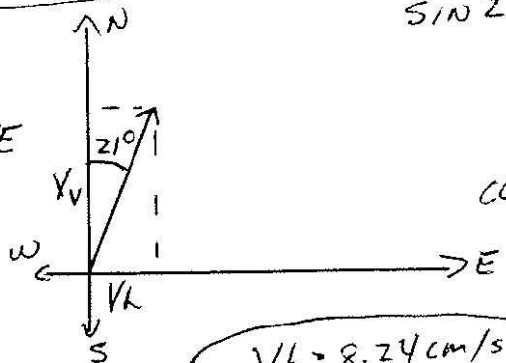
$+ V_V = -9.61m$

$V_V = -9.61m$

$V_h = -1.35m$

#5)

23 cm/s at N 21° E



$\sin 21° = \frac{V_h}{23} \Rightarrow V_h = \sin 21° (23 cm/s)$

$V_h = 8.24 cm/s$

$\cos 21° = \frac{V_V}{23} \Rightarrow V_V = \cos 21° (23 cm/s)$

$V_V = 21.5 cm/s$

$V_h = 8.24 cm/s$

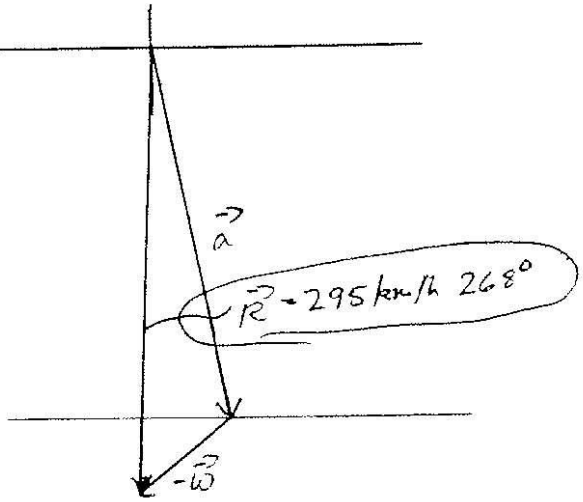
$V_V = 21.5 cm/s$

WORD PROBLEMS

VI 1. $\vec{a}$ = 250 km/h ON A COURSE OF 280°

$\vec{w}$ = 75 km/h from a course of 39°.

1 cm : 50 km/h

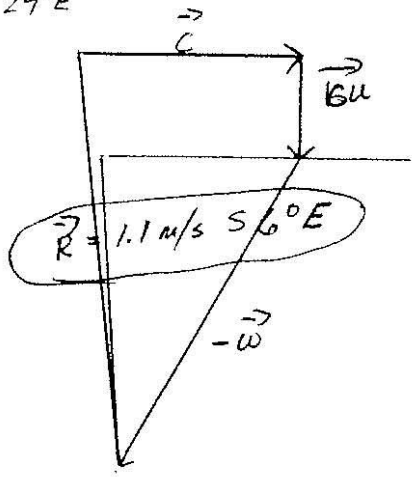


2. $\vec{c}$ = 0.58 m/s E

$\vec{cu}$ = 0.26 m/s S

$\vec{w}$ = 0.94 m/s N 29°E

1 cm : .2 m/s

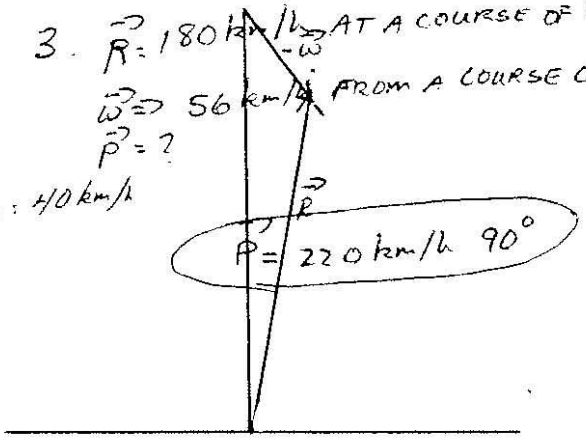


3. $\vec{R}$ = 180 km/h AT A COURSE OF 80°

$\vec{w}$ => 56 km/h FROM A COURSE OF 125°

$\vec{P}$ = ?

1 cm : 40 km/h



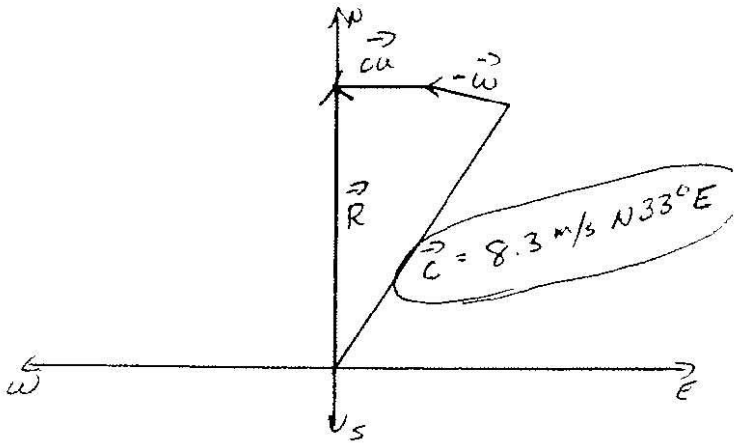
4. $\vec{R}$ = 7.5 m/s N

$\vec{cu}$ = 2.5 m/s W

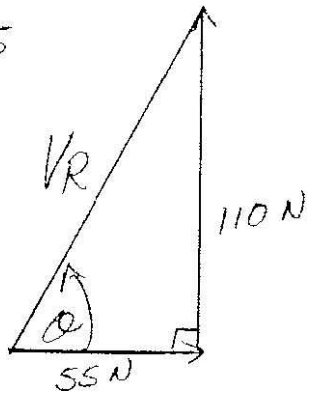
$\vec{w}$ = 2.1 m/s from S 75°E.

$\vec{c}$ = ?

1 cm : 2 m/s



VI # 5



$V_R^2 = 110N^2 + 55N^2$

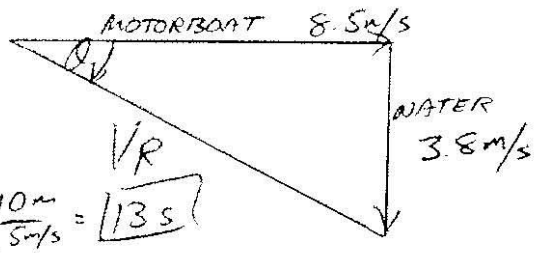
$V_R = 120\ N$

$\tan\theta = \frac{110N}{55N} = 2.0$

$\theta = 63°$

120 N 63°

#6 a)



$V_r = \sqrt{(8.5m/s)^2 + (3.8m/s)^2}$

$= 9.3\ m/s$

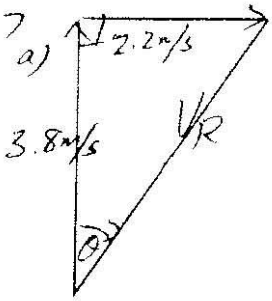
$\tan\theta = \frac{3.8}{8.5} = 0.45$

$\theta = 24°$

9.3m/s 24°

b) $t = \frac{d}{v} = \frac{110m}{8.5m/s} =$ 13s

#7 a)



$V_R = \sqrt{(3.8m/s)^2 + (2.2m/s)^2}$

$= 4.4\ m/s$

4.4m/s 30°

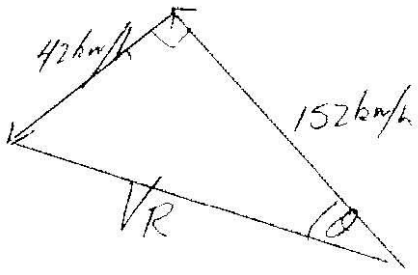
$\tan\theta = \frac{2.2}{3.8} = .58$

$\theta = 30°$

b) $t = \frac{d}{v} = \frac{41m}{3.8m/s} =$ 11s

c) $d = vt = 22m/s(11s) =$ 24m

#8



$V_R = \sqrt{(42km/h)^2 + (152km/h)^2}$

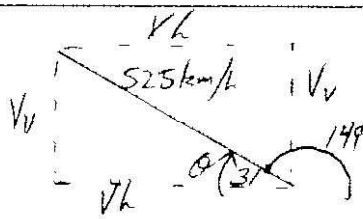
$= 160km/h$

$\tan\theta = \frac{42}{152} = 0.276$

$\theta = 140°$

160km/h 140°

#9



$V_V = V\sin\theta$

$= 525(\sin 31°)$

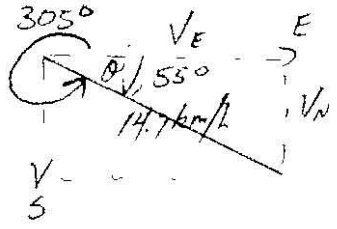
$= 270\ km/h$

$V_h = V\cos\theta$

$= 525km/h(\cos 31°)$

$= 450km/h$

#10



$V_N = V\sin\theta$

$= 14.7km/h\ \sin 55°$

$= 12.0km\ S$

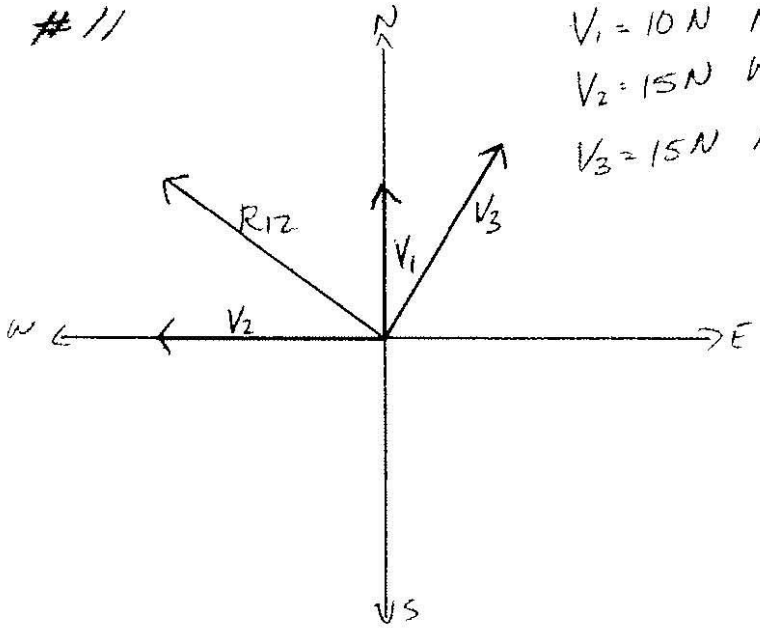
$V_E = V\cos\theta$

$= 14.7km/h\ \cos 55°$

$= 8.43km\ E$

STEP ①

#11



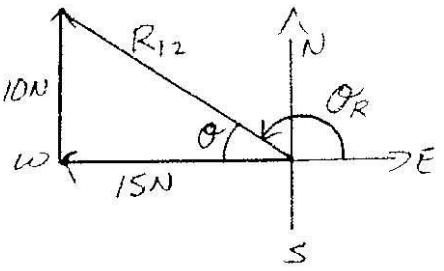
$V_1 = 10\,N \quad N$

$V_2 = 15\,N \quad W$

$V_3 = 15\,N \quad N30^\circ E$

FIND RESULTANT OF V_1 and V_2

USE ANALYTICAL METHOD



R_{12} MAGNITUDE $10^2 + 15^2 = (R_{12})^2$

$100 + 225 = R_{12}^2$

$325 = R_{12}^2 \quad R_{12} = 18\,N$

R_{12} DIRECTION

$180^\circ - \theta = \theta_R$

$\tan\theta = \frac{10}{15} = .6667$

$\theta = 33.7^\circ$

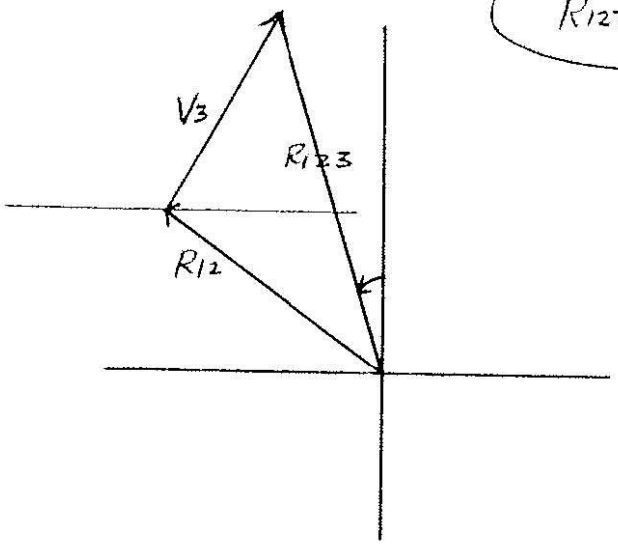
$\therefore \theta_R = 180 - 33.7^\circ = 146.3^\circ$

OR $N56.3^\circ W$

STEP 2. $R_{12} = 18\,N \quad N56.3^\circ W$

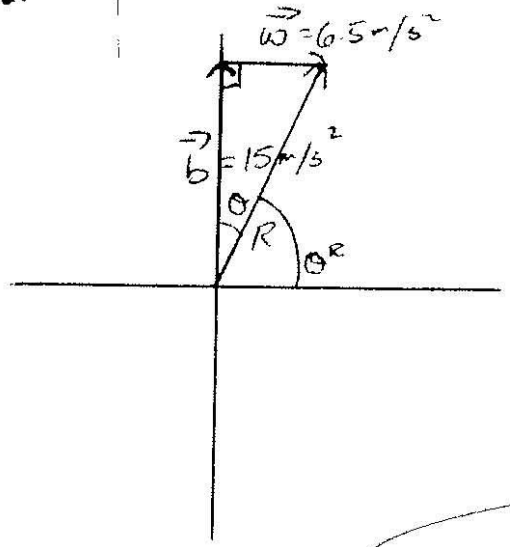
FIND RESULTANT OF R_{12} and V_3

USE GRAPHICAL METHOD



$R_{123} = 25\,N \quad N17^\circ W$

#12



USE ANALYTICAL

FIND MAGNITUDE $(6.5 m/s^2)^2 + (15 m/s^2)^2 = R^2$

$42.25 m^2/s^4 + 225 m^2/s^4 = R^2$

$267.25 m^2/s^4 = R^2$ $\quad R = 16.3 m/s^2$

FIND DIRECTION

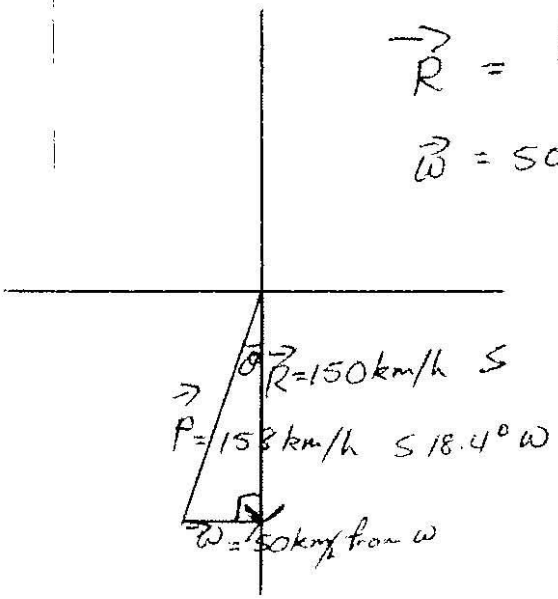
$\tan\theta = \frac{6.5}{15} = 23.4^\circ$

$\theta^R = 90 - 23.4^\circ$

$= 66.6^\circ$

$R = 16.3 m/s^2 \ 66.6^\circ$

#13



$\vec{R} = \text{PLANE} = \frac{450 km}{3 hrs} = 150 km/hr$ S

$\vec{w} = 50 km/h$ from the W

USE ANALYTICAL

MAGNITUDE $R^2 + w^2 = P^2$

$(150)^2 + (50)^2 = P^2$

$22500 + 2500 = P^2$

$25000 = P^2$

$158 km/h = P$

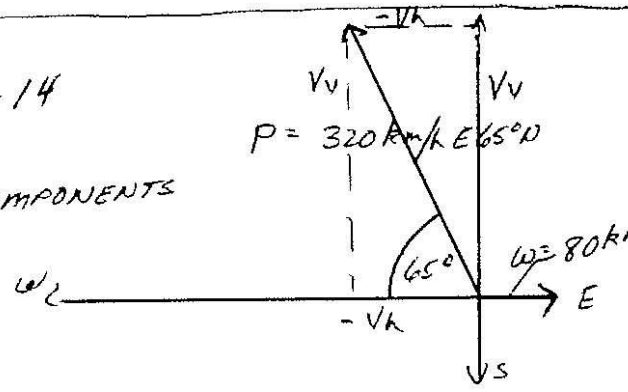
DIRECTION

$\tan\theta = \frac{50}{150} = \frac{1}{3} = .3333.$

$\theta = 18.4^\circ$

$P = 158 km/h \ S 18.4^\circ W$

VI #14



PLANE

$\sin 65^\circ = \frac{Vv_p}{320} \Rightarrow Vv = \sin 65^\circ (320\ km/h)$

$Vv_p = 290\ km/h$

$\cos 65^\circ = \frac{-Vh_p}{320} \Rightarrow -Vh = \cos 65^\circ (320\ km/h)$

$Vh_p = -135\ km/h$

WIND

$\sin 0^\circ = \frac{Vv_w}{80} \Rightarrow Vv_w = 0\ km/h$

$\cos 0^\circ = \frac{Vh_w}{80} \Rightarrow Vh_w = \cos 0^\circ (80\ km/h)$

$= 80\ km/h$

RESULTANT => COURSE OF PLANE = $Vv_{NET} = Vv_p + Vv_w = 290\ km/h$

$Vh_{NET} = Vh_p + Vh_w = -135\ km/h + 80\ km/h = -55\ km/h$

MAGNITUDE = $(Vv_{NET})^2 + (Vh_{NET})^2 = R^2 \Rightarrow R = \sqrt{(Vv_{NET})^2 + (Vh_{NET})^2}$

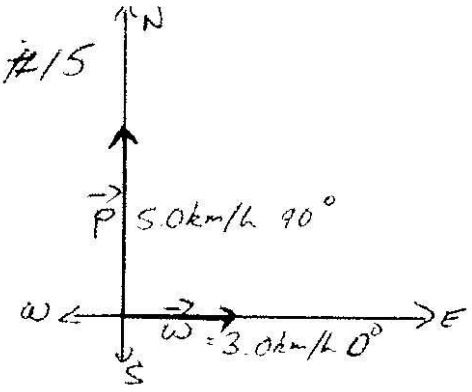
$= \sqrt{(290\ km/h)^2 + (55\ km/h)^2}$

$= 295\ km/h$

direction $\tan \alpha = \frac{Vh_{NET}}{Vv_{NET}} = \frac{-55}{290} = -11^\circ$ OR $N\ 11^\circ W$

PLANE WILL FLY 295 km N 11° W

#15



COMPONENTS

$P \Rightarrow \begin{cases} V_{hp} = 0 \text{ km/h} \\ V_{vp} = 5.0 \text{ km/h} \end{cases}$

$W \Rightarrow \begin{cases} V_{hw} = 3.0 \text{ km/h} \\ V_{vw} = 0 \text{ km/h} \end{cases}$

$V_{h\,NET} = V_{hp} + V_{hw} = 0 + 3 = 3.0 \text{ km/h}$

$V_{v\,NET} = V_{vp} + V_{vw} = 5 \text{ km/h} + 0 = 5 \text{ km/h}$

RESULTANT MAG $\Rightarrow = \sqrt{(V_{h\,NET})^2 + (V_{v\,NET})^2}$

$= \sqrt{(3.0 \text{ km/h})^2 + (5 \text{ km/h})^2}$

$= \sqrt{9 \text{ km}^2/\text{h}^2 + 25 \text{ km}^2/\text{h}^2} = \sqrt{34 \text{ km}^2/\text{h}^2}$

$= 5.8 \text{ km/h}$

DIRECTION $\tan\theta = \frac{V_{h\,NET}}{V_{v\,NET}} = \frac{3}{5} = .6$

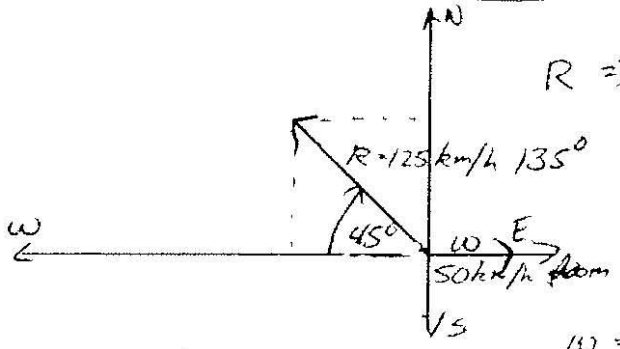
$\theta = 31°$

a) ACTUAL VELOCITY IS 5.8 km/h

b) 1.5 km

c) $d = 5.0 \text{ km/h}(.5\text{h}) = 2.5 \text{ km}$

#16



$R \Rightarrow \begin{cases} \sin 45° = \frac{V_{v\,NET}}{125} \Rightarrow V_{v\,NET} = \sin 45° (125) \\ V_{v\,NET} = 88.4 \text{ km/h} \\ \cos 45° = -\frac{V_{h\,NET}}{125} \Rightarrow -V_{h\,NET} = \cos 45° (125) \\ V_{h\,NET} = -88.4 \text{ km/h} \end{cases}$

$W \Rightarrow \begin{cases} V_v = 0 \\ V_h = +50 \text{ km/h} \end{cases}$

Plane would travel 164 km/h N57°W

PLANE $\Rightarrow V_{v\,NET} = V_{vp} + V_{vw} \Rightarrow V_{vp} = V_{v\,NET} - V_{vw}$

$= 88.4 \text{ km/h} - 0 = 88.4 \text{ km/h}$

$V_{h\,NET} = V_{hp} + V_{hw} \Rightarrow V_{hp} = V_{h\,NET} - V_{hw} = -88 \text{ km/h} + 50 \text{ km/h}$

$= -138 \text{ km/h}$

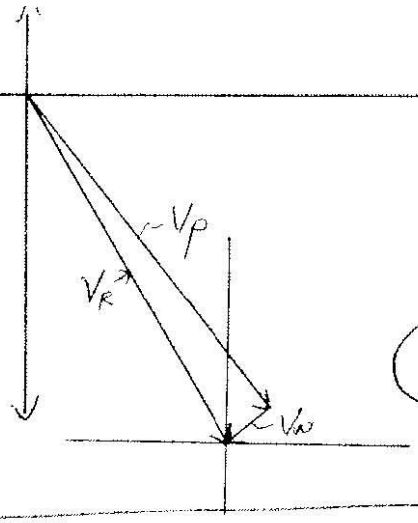
MAGNITUDE $= \sqrt{(88.4)^2 + (138)^2}$

$= \sqrt{26858.56} = 163.9 \text{ km/h}$

DIRECTION $\tan\theta = \frac{V_{hp}}{V_{vp}} = \frac{-138.4 \text{ km/h}}{88.4 \text{ km/h}} = 1.5656$ $\theta = 57°$

N 57° W

#17



1 cm : 100 km/h

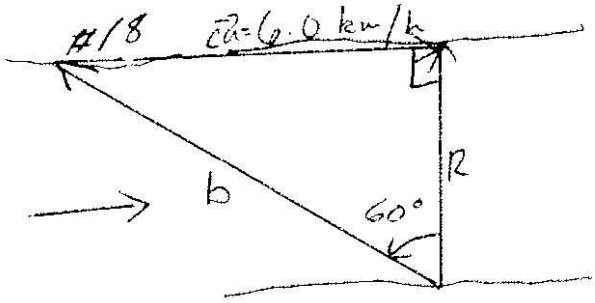
USE GRAPHICAL METHOD

$V_P = \frac{830\,km}{1.5\,h} = 553\ km/h\ S\ 30°E$

$V_w = 70\ km/h\ W\ 40°S$

$V_p = 540\ km/h\ S\ 38°E$

#18 $\vec{c}u = 6.0\ km/h$



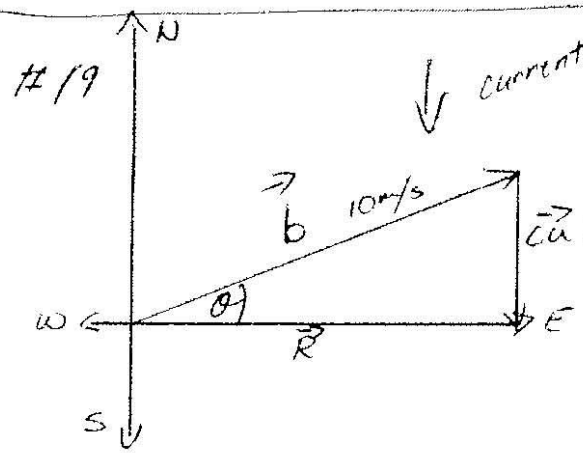
$\vec{c}u = 6.0\ km/h$

USE ANALYTICAL METHOD

$\sin 60° = \frac{cu}{b}$

$b = \frac{6.0\ km/h}{\sin 60°} = 6.9\ km/h$

#19



USE ANALYTICAL METHOD

a) FIND θ $\sin\theta = \frac{3.7\ m/s}{10\ m/s} = .37$

$\theta = 21.7°$

b) FIND MAGNITUDE OF RESULTANT

$R^2 + cu^2 = b^2$

$R^2 = b^2 - cu^2$

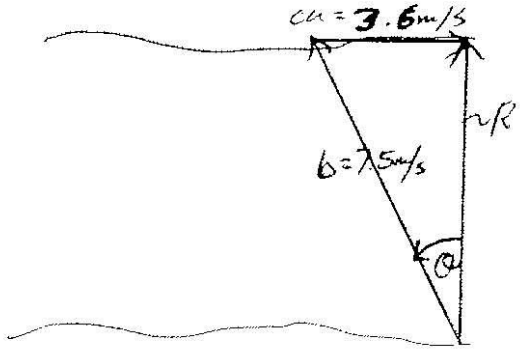
$(10\ m/s)^2 - (3.7\ m/s)^2 = 86.31\ m^2/s^2$

$R = 9.3\ m/s$

$t = \frac{d}{v} = \frac{500\ m}{9.3\ m/s} = 53.8\ s$

$t = 53.8\ s$

#20



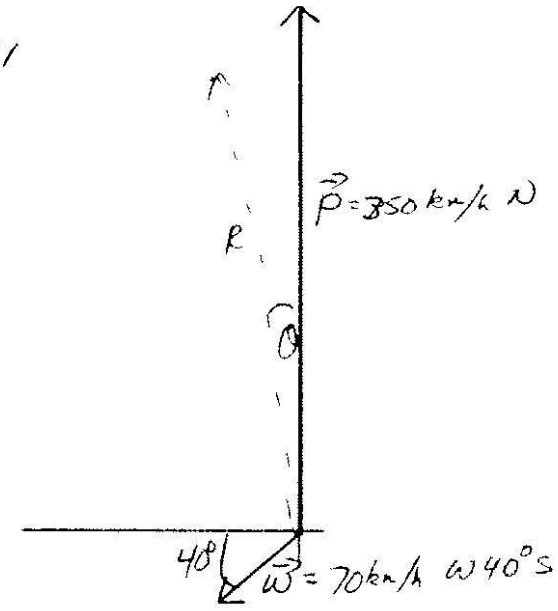
FIND θ

USE ANALYTICAL METHOD

$\sin\theta = \frac{3.6\ m/s}{7.5\ m/s} = .48$

$\theta = 28.7°$ downstream

#21



USE COMPONENT METHOD

PLANE $\begin{cases} V_{hp} = 0 \text{ km/h} \\ V_{vp} = 350 \text{ km/h} \end{cases}$

WIND $\begin{cases} \sin\theta = \dfrac{-V_{vw}}{70 \text{km/h}} & -V_{vw} = \sin 40^\circ (70) \\ & V_{vw} = -45 \text{km/h} \\ \cos\theta = \dfrac{-V_{hw}}{70 \text{km/h}} & -V_{hw} = \cos 40^\circ (70) \\ & V_{hw} = -53.6 \text{km/h} \end{cases}$

$V_{hNET} = V_{hp} + V_{hw} = -53.6 \text{ km/h}$

$V_{vNET} = V_{vp} + V_{vw} = 350 \text{km/h} - 45 \text{km/h} = 305 \text{km/h}$

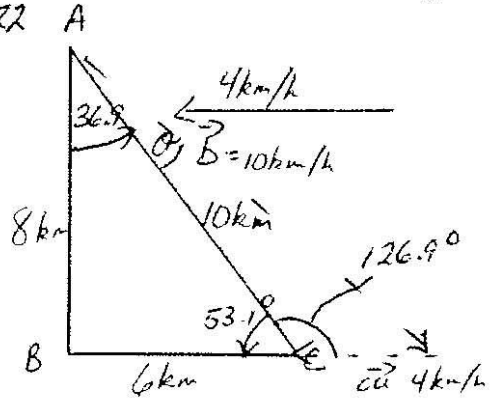
RESULTANT MAG. $= \sqrt{(V_{hNET})^2 + (V_{vNET})^2}$

$= \sqrt{(305 \text{km/h})^2 + (-53.6 \text{km/h})^2} = 310 \text{km/h}$

DIRECTION $\tan\theta = \dfrac{V_{hNET}}{V_{vNET}} = \dfrac{-53.6}{305} = -.1757$

$\theta = -10^\circ$ OR (N 10° W)

#22



DIRECTION USE LAW OF SINES

$\dfrac{4 \text{km/h}}{\sin\theta} = \dfrac{10 \text{km/h}}{\sin 126.9}$

$\sin\theta = \dfrac{4(\sin 126.9)}{10} =$

$\theta = 18.7^\circ$

DIRECTION IS $36.9 + 18.7 =$ (55.6° upstream)

To find time use LAW OF COSINES

$b^2 = a^2 + c^2 - 2ac\cos\beta$

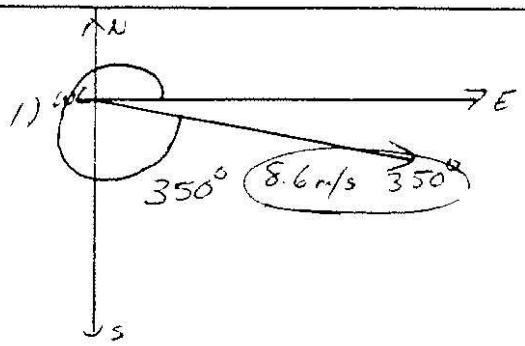
$(10 \text{km/h}\, t)^2 = (4 \text{km/h}\, t)^2 + (10 \text{km})^2 - 2(4 \text{km/h}\, t)(10 \text{km})\cos 126.9^\circ$

$100 \text{km}^2/\text{h}^2\, t^2 = 16 \text{km}^2/\text{h}^2\, t^2 + 100 \text{km}^2 + 48t \text{km}^2/\text{h} \Rightarrow 84 \text{km}^2/\text{h}^2\, t^2 - 48t \text{km}^2/\text{h} - 100 \text{km}^2 = 0$

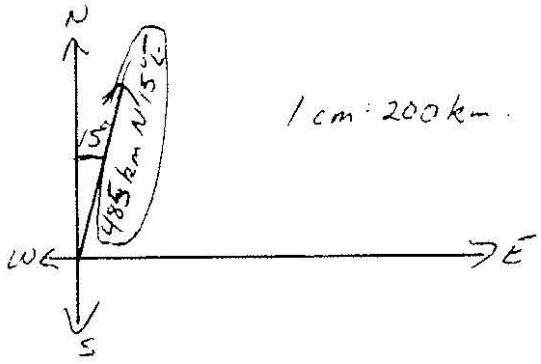
$21t^2 - 12t - 25 = 0$ ($t = 1.41$ hours)

SOLUTIONS PHYSICS 30 REVIEW UNIT 1 PART 2

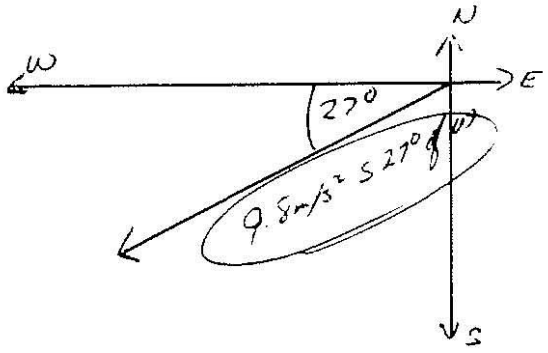
I

1) 

1 cm : 2 m/s

2) 

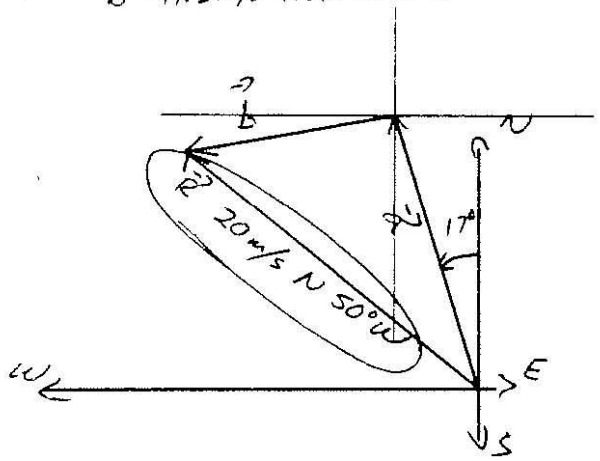
1 cm : 200 km

3) 

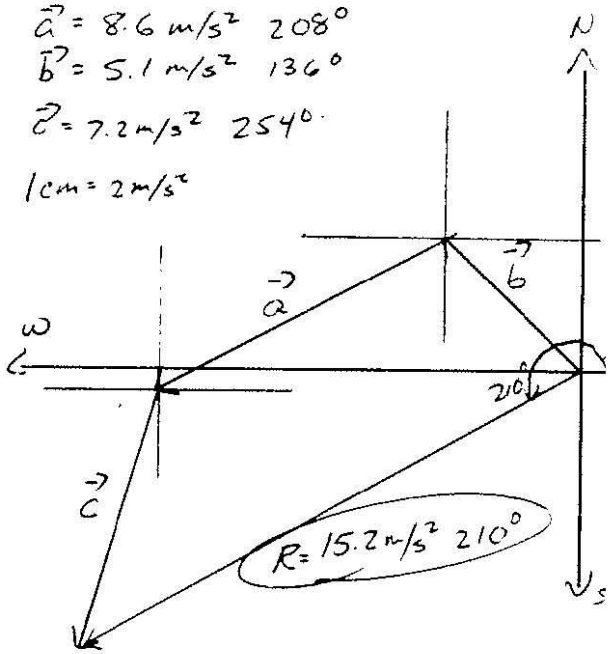
1 cm = 2 m/s²

II

1) $\vec{a}$ = 14.5 m/s at N 17° W
$\vec{b}$ = 11.2 m/s from N 80° E
1 cm : 4 m/s

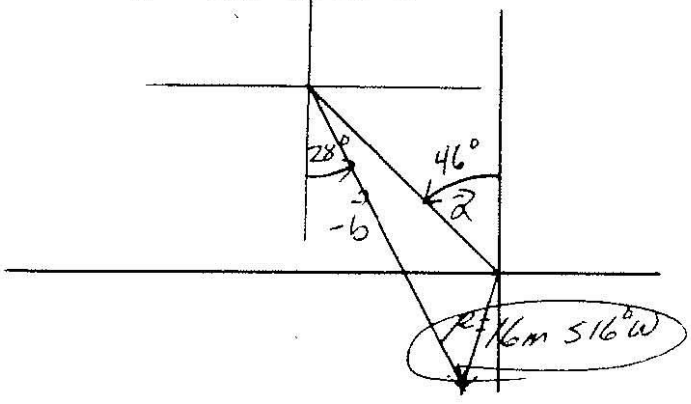


2) $\vec{a}$ = 8.6 m/s² 208°
$\vec{b}$ = 5.1 m/s² 136°
$\vec{c}$ = 7.2 m/s² 254°
1 cm = 2 m/s²

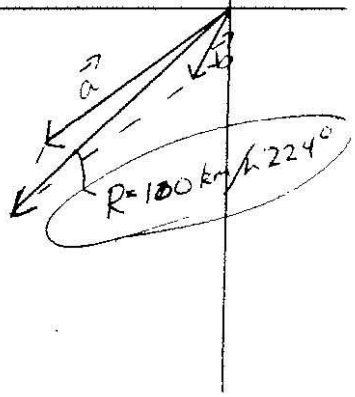


III

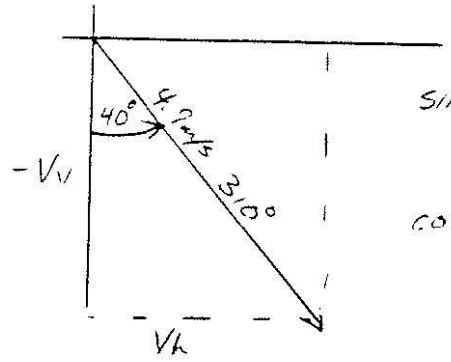
1) $\vec{a}$ = 36 m at 46° WITH VERTICAL
$\vec{b}$ = 45 m at 28° WITH THE SAME VERT
1 cm : 4 m



2) $\vec{a}$ = 75 km/h course of 216°
$\vec{b}$ = 26 km/h from a course of 252
1 cm : 25 km/h



IV 1) 4.9 m/s AT A COURSE OF 310°

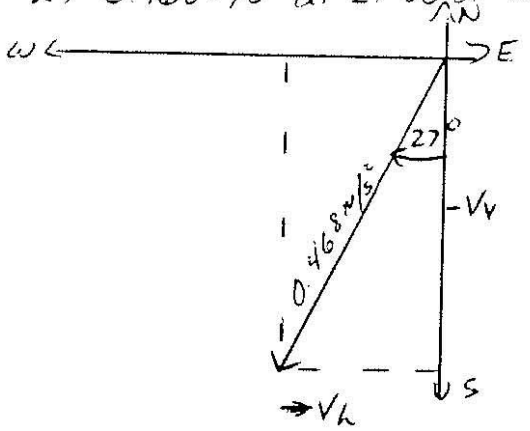


$\sin 40° = \frac{Vh}{4.9\ m/s}$ $\quad Vh = \sin 40°(4.9\ m/s) = 3.15\ m/s$

$\cos 40° = \frac{-Vv}{4.9\ m/s}$ $\quad -Vv = \cos 40°(4.9\ m/s) = 3.8\ m/s$

$Vv = -3.8\ m/s$

2) $0.468\ m/s^2$ at 27° W of S



1 cm : $0.1\ m/s^2$

$\sin 27° = \frac{-Vh}{0.468\ m/s^2}$ $\quad -Vh = \sin 27°(0.468\ m/s^2)$

$Vh = -.212\ m/s^2$

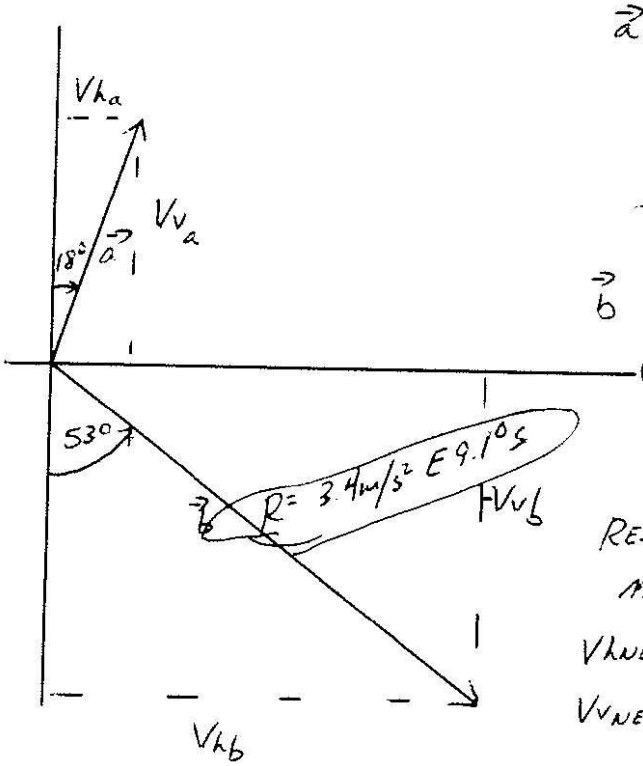
$\cos 270 = \frac{-Vv}{0.468\ m/s^2}$ $\quad -Vv = \cos 27°(0.468\ m/s^2)$

$Vv = -.417\ m/s^2$

V #1) $\vec{a} = 1.7\ m/s^2$ at N 18° E

$\vec{b} = 3.6\ m/s^2$ at S 53° E

1 cm : $0.5\ m/s^2$



$\vec{a}$:

$\sin 18° = \frac{Vha}{1.7\ m/s}$ $\quad Vha = \sin 18°(1.7\ m/s)$

$Vha = 0.525\ m/s$

$\cos 18° = \frac{Vva}{1.7\ m/s}$ $\quad Vva = \cos 18°(1.7\ m/s)$

$Vva = 1.62\ m/s$

$\vec{b}$:

$\sin 53° = \frac{Vhb}{3.6}$ $\quad Vhb = \sin 53°(3.6\ m/s^2)$

$Vhb = 2.88\ m/s^2$

$\cos 53° = \frac{-Vvb}{3.6}$ $\quad -Vvb = \cos 53°(3.6)$

$-Vvb = 2.17$ $\quad Vvb = -2.17\ m/s^2$

RESULTANT

MAGNITUDE $= \sqrt{(Vh_{NET})^2 + (Vv_{NET})^2}$

$Vh_{NET} = Vha + Vhb = 0.525\ m/s + 2.88\ m/s^2 = 3.4\ m/s^2$

$Vv_{NET} = Vva + Vvb = 1.62\ m/s + (-2.17\ m/s^2) = -0.55\ m/s^2$

$MAG = \sqrt{(3.4\ m/s^2)^2 + (0.55\ m/s^2)^2} = 3.4\ m/s^2$

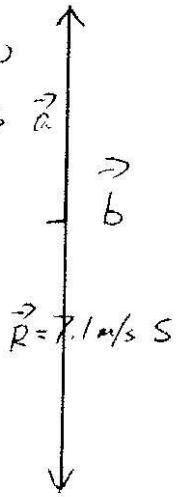
DIRECTION $\tan \theta = \frac{Vv_{NET}}{Vh_{NET}} = -9.2°$ OR E 9.1° S

#2)

1 cm = 2 m/s

$\vec{a}$ = 5.6 m/s N

$\vec{b}$ = 12.7 m/s S



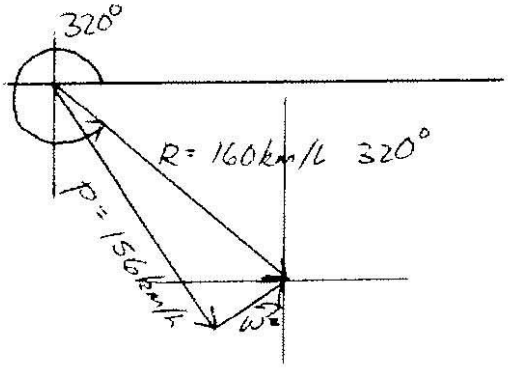
Relative to the ground the persons velocity is 7.1 m/s S.

#3)

1 cm : 40 km/h

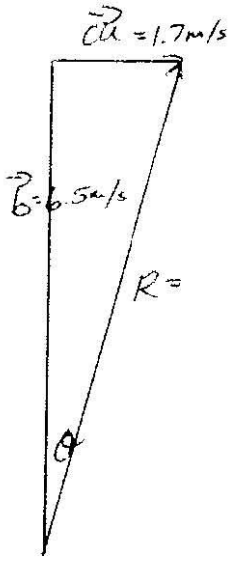
$\vec{R}$ = 160 km/h at 320°

$\vec{w}$ = 45 km/h from 215°



The planes velocity is 156 km/h at a heading of 303°

#4)



$\vec{cu}$ = 1.7 m/s E

b = 6.5 m/s

R MAGNITUDE $= \sqrt{(1.7 \text{ m/s})^2 + (6.5 \text{ m/s})^2}$

$= 6.7$ m/s

DIRECTION $\tan\theta = \frac{1.7}{6.5} = .2615$

$\theta = 14.7°$

The fisherman will travel at 6.7 m/s N 14.7° E